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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>A61K</b>	<b>A2</b>	(11) International Publication Number: <b>WO 98/01100</b> (43) International Publication Date: 15 January 1998 (15.01.98)									
<p>(21) International Application Number: PCT/US97/11792</p> <p>(22) International Filing Date: 3 July 1997 (03.07.97)</p> <p>(30) Priority Data:</p> <table border="0"><tr><td>60/021,420</td><td>9 July 1996 (09.07.96)</td><td>US</td></tr><tr><td>9617898.3</td><td>28 August 1996 (28.08.96)</td><td>GB</td></tr><tr><td>60/029,351</td><td>31 October 1996 (31.10.96)</td><td>US</td></tr></table> <p>(71) Applicant (for all designated States except US): MERCK &amp; CO., INC. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065 (US).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): MITCHEL, Yale, B. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065 (US). TOBERT, Jonathan, A. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065 (US).</p> <p>(74) Common Representative: MERCK &amp; CO., INC.; 126 East Lincoln Avenue, Rahway, NJ 07065 (US).</p>		60/021,420	9 July 1996 (09.07.96)	US	9617898.3	28 August 1996 (28.08.96)	GB	60/029,351	31 October 1996 (31.10.96)	US	<p>(81) Designated States: AL, AM, AU, AZ, BA, BB, BG, BR, BY, CA, CN, CU, CZ, EE, GE, HU, IL, IS, JP, KG, KR, KZ, LC, LK, LR, LT, LV, MD, MG, MK, MN, MX, NO, NZ, PL, RO, RU, SG, SI, SK, SL, TJ, TM, TR, TT, UA, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i></p>
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<p>(54) Title: METHOD FOR TREATING HOMOZYGOUS FAMILIAL HYPERCHOLESTEROLEMIA</p> <p>(57) Abstract</p> <p>Homozygous familial hypercholesterolemia can be treated in patients suffering with this condition by administering a therapeutically effective amount of simvastatin. Dosages above 40 mg/day, and more particularly at or above 80 mg/day, were found to effectively reduce the LDL cholesterol levels in these patients.</p>											

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- 1 -

TITLE OF THE INVENTIONMETHOD FOR TREATING HOMOZYGOUS FAMILIAL  
HYPERCHOLESTEROLEMIA5 RELATED APPLICATIONS

This application is a continuing application and claims priority to U.S. provisional application number 60/021,420, filed July 9, 1996, and to U.S. provisional application number 60/029,351, filed October 31, 1996.

10

BACKGROUND OF THE INVENTION

Homozygous familial hypercholesterolemia (HFH) is a rare disorder characterized by the presence of two abnormal low density lipoprotein (LDL) receptor genes which results in the patient having  
15 dysfunctional LDL receptors. This results in severe hypercholesterolemia, particularly extreme elevations in LDL levels, and rapid development of coronary atherosclerosis and coronary heart disease in those who suffer with HFH. Most patients develop coronary disease in adolescence and usually do not survive beyond their teen-age  
20 years.

HMG-CoA reductase inhibitors such as compactin, lovastatin, simvastatin, pravastatin, etc., are believed to work by upregulating LDL receptor activity and increasing LDL removal from the blood. Since FH homozygotes do not have functional LDL  
25 receptors, this class of drugs was generally believed to be ineffective in these patients. Previous experience with HMG-CoA reductase inhibitors in FH homozygote children bore this out. For example, in J. Thiery, et al., *European Journal of Pediatrics*, (1990) 149: 716-721, it is noted that compactin, at dosages as high as 200 mg per day, and lovastatin caused  
30 only marginal lowering of LDL cholesterol levels in HFH patients and therefore were not considered to be useful therapies for this condition.

The treatment options available to those suffering with HFH have been limited to liver transplantation or LDL aphaeresis therapy. LDL aphaeresis is a technique where plasma is removed from patients

- 2 -

and run over columns either with an antibody to apo B or reagents to precipitate LDL. It is usually performed once every two weeks in this population with about a 70% reduction in LDL cholesterol immediately after the procedure, with levels returning to baseline at one week post-treatment. Both treatment options are associated with considerable morbidity and are in limited supply.

More recently, a second-generation HMG-CoA reductase inhibitor, atorvastatin, has been shown to be useful for treating HFH.

Contrary to what was previously believed due to the nature of HFH and the mechanism of action understood to be associated with HMG-CoA reductase inhibitors as well as the available published studies in this field, it has been discovered that simvastatin (marketed in the U.S. under the trademark ZOCOR®) in doses above 40 mg per day can be used to treat patients suffering with HFH.

#### SUMMARY OF THE INVENTION

The main object of the instant invention is to provide a method for treating homozygous familial hypercholesterolemia comprising administering a therapeutically effective amount of simvastatin to a person in need of such treatment. A person in need of such treatment is one who has homozygous familial hypercholesterolemia. Additional objects will be evident from the following detailed description.

#### DETAILED DESCRIPTION OF THE INVENTION

It has been found that simvastatin in daily dosages above 40 mg are useful for the treatment of HFH. Preferably, the daily dosage is at least 80 mg, and more preferably, at least 160 mg. The compound may be administered in a single daily dose, or divided doses, for example two, three or four times daily. Simvastatin may also be administered in a sustained release formulation, for example employing the formulation described in U.S. Patent No. 5,366,738. Sustained release and daily divided dose administration is preferred.

- 3 -

The following study results demonstrate the usefulness of simvastatin in the treatment of HFH.

### I. Study Design

5

Design: double blinded, randomized, parallel, dose-escalation, controlled, 18 week study

Patients: 12 patients with well-characterized HFH

10 Treatment: After a 4 week placebo diet run in period, the 12 patients were randomized to simvastatin (S) 80 mg/day (group 1, n=8) or 40 mg/day (group 2, n=4). After 9 weeks, the dose in group 1 was increased to 160 mg/day while the dose in group 2 was kept at 40 mg/day and treatment continued for an additional 9 weeks. Simvastatin was administered orally. The simvastatin treatment information is  
15 summarized in the table, below.

	Period 1 (9 weeks)	Period 2 (9 weeks)
Group 1 (n=8):	80 mg/day in 3 divided doses	160 mg/day in 3 divided doses
Group 2 (n=4):	40 mg/day once a day	40 mg/day in 3 divided doses

Endpoint: Change in low density lipoprotein cholesterol

20

### II. Study Results

The results of the study are as follows. For T-C, LDL-C and HDL-C, mean baseline and mean % change from baseline are shown; for TRIG, median baseline and median % change from baseline  
25 are shown:

- 4 -

	<u>GROUP 1</u>			<u>GROUP 2</u>		
	(n=8)			(n=4)		
	BL	80	160	BL	40	40
	(mg/dl)	mg/day	mg/day	(mg/dl)	mg/day	mg/day
		<u>tid dosing</u>	<u>tid dosing</u>		<u>hs</u>	<u>tid dosing</u>
		% change	% change		% change	% change
T-C	627	-23	-29	562	-12	-13
LDL-C	570	-25	-31	519	-14	-15
TRIG	136	-9	-15	72	7	-11
HDL-C	32	12	6	28	11	17

BL = baseline

5 T-C = total cholesterol

LDL-C = low density lipoprotein cholesterol

TRIG = triglyceride level

HDL-C = high density lipoprotein cholesterol

10 All 12 patients completed the trial and there were no serious or unexpected adverse events. No patients sustained significant hepatic transaminase or creatine kinase elevations.

As can be seen from the above study results, simvastatin at therapeutically effective doses of 80 mg/day and higher is effective in  
 15 lowering LDL-C in patients suffering with homozygous familial hypercholesterolemia.

As such, simvastatin may be administered as monotherapy to a patient suffering with HFH, or it may be administered in combination with other therapies which are suitable for the treatment of  
 20 HFH. For example, simvastatin may be co-administered with one or more additional drugs which are effective in lowering LDL cholesterol such as HMG-CoA synthase inhibitors; squalene epoxidase inhibitors; squalene synthetase inhibitors (also known as squalene synthase inhibitors), acyl-coenzyme A: cholesterol acyltransferase (ACAT)

- 5 -

inhibitors; probucol; niacin; fibrates such as clofibrate, fenofibrate, and gemfibrozil; cholesterol absorption inhibitors; and bile acid sequestrants. Agents such as aspirin and beta-blockers may also be co-administered with simvastatin. Simvastatin may also be administered in  
5 conjunction with therapies such as LDL aphaeresis.

While the invention has been described and illustrated with reference to certain particular embodiments thereof, those skilled in the art will appreciate that various changes, modifications and substitutions can be made therein without departing from the  
10 spirit and scope of the invention. For example, effective dosages other than the particular dosages as set forth herein above may be applicable as a consequence of variations in the responsiveness of the mammal being treated. Likewise, the specific pharmacological responses observed may vary depending upon the particular  
15 pharmaceutical carriers employed, as well as the type of formulation and mode of administration employed, and such expected variations or differences in the results are contemplated in accordance with the objects and practices of the present invention. It is intended, therefore, that the invention be defined by the scope of the claims  
20 which follow and that such claims be interpreted as broadly as is reasonable.

- 6 -

WHAT IS CLAIMED IS:

1. A method of treating homozygous familial hypercholesterolemia comprising administering a therapeutically effective amount of simvastatin to a person in need of such treatment.  
5
2. The method of claim 1 wherein the daily dosage of simvastatin is more than 40 mg.
- 10 3. The method of claim 2 wherein the daily dosage of simvastatin is at least 80 mg.
4. The method of claim 3 wherein the daily dosage of simvastatin is 80 mg.  
15
5. The method of claim 2 wherein the daily dosage of simvastatin is at least 160 mg.
- 20 6. The method of claim 5 wherein the daily dosage of simvastatin is 160 mg.
7. The method of claim 1 wherein the simvastatin is administered in a single daily dose.
- 25 8. The method of claim 1 wherein the simvastatin is administered in divided daily doses.
9. The method of claim 1 wherein the simvastatin is administered in a controlled time-release formulation.  
30

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<p>(21) International Application Number: PCT/US97/11792</p> <p>(22) International Filing Date: 3 July 1997 (03.07.97)</p> <p>(30) Priority Data:</p> <table border="0"> <tr> <td>60/021,420</td> <td>9 July 1996 (09.07.96)</td> <td>US</td> </tr> <tr> <td>9617898.3</td> <td>28 August 1996 (28.08.96)</td> <td>GB</td> </tr> <tr> <td>60/029,351</td> <td>31 October 1996 (31.10.96)</td> <td>US</td> </tr> </table> <p>(71) Applicant (for all designated States except US): MERCK &amp; CO., INC. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065 (US).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): MITCHEL, Yale, B. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065 (US). TOBERT, Jonathan, A. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065 (US).</p> <p>(74) Common Representative: MERCK &amp; CO., INC.; 126 East Lincoln Avenue, Rahway, NJ 07065 (US).</p>	60/021,420	9 July 1996 (09.07.96)	US	9617898.3	28 August 1996 (28.08.96)	GB	60/029,351	31 October 1996 (31.10.96)	US	<p>(81) Designated States: AL, AM, AU, AZ, BA, BB, BG, BR, BY, CA, CN, CU, CZ, EE, GE, HU, IL, IS, JP, KG, KR, KZ, LC, LK, LR, LT, LV, MD, MG, MK, MN, MX, NO, NZ, PL, RO, RU, SG, SI, SK, SL, TJ, TM, TR, TT, UA, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> <p>(88) Date of publication of the international search report: 12 February 1998 (12.02.98)</p>
60/021,420	9 July 1996 (09.07.96)	US								
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EE	Estonia						

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/11792

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A61K 31/365

US CL : 514/460

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 514/460

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CHEMICAL ABSTRACTS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). Lancet. November 1994, Vol. 19:344, pages 1383-9 (1994) (Abstract).	1-9
A	US, 5,393,893 A (KUBELA et al.) 28 February 1995, see entire document.	1-9
A	US, 4,997,849 A (PETUCH et al.) 05 March 1991, see entire document.	1-9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JAMES H. REAMER Telephone No. (703) 308-1235

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Basic Patent (No,Kind,Date): GB 9617898 A0 19961009 <No. of Patents: 007>

Patent Family:

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AU 9736672	A1	19980202	AU 9736672	A	19970703	
AU 9742289	A1	19980202	AU 9742289	A	19970703	
AU 9743261	A1	19980202	AU 9743261	A	19970703	
GB 9617898	A0	19961009	GB 9617898	A	19960828	(BASIC)
WO 9801116	A1	19980115	WO 97US12426	A	19970703	
WO 9801100	A2	19980115	WO 97US11792	A	19970703	
WO 9801119	A2	19980115	WO 97US10867	A	19970703	

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GB 9617898 A 19960828  
US 21420 P 19960709  
US 29351 P 19961031  
WO 97US12426 W 19970703  
WO 97US11792 W 19970703

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PATENT FAMILY:

AUSTRALIA (AU)

Patent (No,Kind,Date): AU 9736672 A1 19980202  
THERAPY FOR COMBINED HYPERLIPIDEMIA (English)  
Patent Assignee: MERCK & CO INC  
Author (Inventor): MITCHEL YALE B; MELINO MICHAEL R  
Priority (No,Kind,Date): GB 9617898 A 19960828; US 21420 P  
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METHOD FOR TREATING HOMOZYGOUS FAMILIAL HYPERCHOLESTEROLEMIA (English)  
Patent Assignee: MERCK & CO INC  
Author (Inventor): MITCHEL YALE B; TOBERT JONATHAN A  
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Applic (No,Kind,Date): AU 9742289 A 19970703  
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PHARMACEUTICAL COMPOSITIONS (English)  
Patent Assignee: MERCK & CO INC  
Author (Inventor): MITCHEL YALE B; TOBERT JONATHAN A  
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Language of Document: English

GREAT BRITAIN (GB)

Patent (No,Kind,Date): GB 9617898 A0 19961009  
METHOD FOR TREATING HOMOZYGOUS FAMILIAL HYPERCHOLESTEROLEMIA (English)  
Patent Assignee: MERCK & CO INC  
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Patent Assignee: MERCK & CO INC (US); MITCHEL YALE B (US); MELINO  
MICHAEL R (US)  
Author (Inventor): MITCHEL YALE B (US); MELINO MICHAEL R (US)  
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MN; MX; NO; NZ; PL; RO; RU; SG; SI; SK; SL; TJ; TM; TR; TT; UA; US;  
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 LS; MW; SD; SZ; UG; ZW; AT; BE; CH; DE; DK; ES; FI; FR; GB; GR; IE;  
 IT; LU; MC; NL; PT; SE; BF; BJ; CF; CG; CI; CM; GA; GN; ML; MR; NE;  
 SN; TD; TG

Filing Details: WO 100000 With international search report  
 IPC: \* A61K-009/20  
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 128(09)097716K  
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 98-110207  
 Language of Document: English  
 Patent (No,Kind,Date): WO 9801100 A2 19980115  
 METHOD FOR TREATING HOMOZYGOUS FAMILIAL HYPERCHOLESTEROLEMIA (English)  
 Patent Assignee: MERCK & CO INC (US); MITCHEL YALE B (US); TOBERT  
 JONATHAN A (US)  
 Author (Inventor): MITCHEL YALE B (US); TOBERT JONATHAN A (US)  
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 MD; MG; MK; MN; MX; NO; NZ; PL; RO; RU; SG; SI; SK; SL; TJ; TM; TR;  
 TT; UA; US; UZ; VN; YU; AM; AZ; BY; KG; KZ; MD; RU; TJ; TM  
 (Regional) GH; KE; LS; MW; SD; SZ; UG; ZW; AT; BE; CH; DE; DK; ES; FI  
 ; FR; GB; GR; IE; IT; LU; MC; NL; PT; SE; BF; BJ; CF; CG; CI; CM; GA;  
 GN; ML; MR; NE; SN; TD; TG  
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 JONATHAN A (US)  
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WO 9801100	P	19960709	WO AA	PRIORITY CLAIMED
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WO 9801100	P	19980520	WO 121	EP: PCT APP. ART. 158 (1) (EP: PCT ANM. ART. 158 (1))
WO 9801100	P	19990604	WO NENP	<u>NON-ENTRY INTO THE NATIONAL PHASE IN:</u>
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WO 9801100	P	20000209	WO 122	<u>EP: PCT APP. NOT ENT. EUROP. PHASE (EP: PCT ANM. NICHT IN EUROP. PHASE EING.)</u>
WO 9801116	P	19960709	WO AA	PRIORITY CLAIMED
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WO 9801119	P	19980312	WO DFPE	REQUEST FOR PRELIMINARY EXAMINATION FILED PRIOR TO EXPIRATION OF 19TH MONTH FROM PRIORITY DATE
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WO 9801119	P	19991110	WO 122	<u>EP: PCT APP. NOT ENT. EUROP.</u> PHASE (EP: PCT ANM. NICHT IN EUROP. PHASE EING.)
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